CLAIMS

What is claimed is:

1. A microchannel device, comprising:

a plastic substrate having a microchannel formed therein, said microchannel having a geometry with at least one spatial dimension on the order of micrometers;

polyelectrolyte layers comprising alternating layers of at least one net positively charged layer or net negatively charged layer, said polyelectrolyte layers disposed along at least a portion of a microchannel surface; and

a lid disposed over said microchannel and having a lid surface facing said microchannel.

2. The microchannel device of claim 1, wherein said plastic is selected from the group consisting of polystyrene, poly (ethylene terephthalate glycol), poly (methyl methacrylate), and polycarbonate.

3. The microchannel device of claim 1, wherein said net negative charged layer comprises poly (styrene sulfonate).

4. The microchannel device of claim 1, wherein said net positive charged layer comprises poly (allylamine hydrochloride).

5. The microchannel device of claim 1, wherein said lid is formed of one of an elastomeric polymer, a hard plastic and a laminating film.

6. The microchannel device of claim 1, wherein said polyelectrolyte layers are disposed on said lid surface.

7. The microchannel device of claim 6, wherein an outermost layer of said polyelectrolyte layers disposed on said lid surface comprises a negatively charged portion and a positively charged portion.

8. The microchannel device of claim 1, wherein an outermost layer of said polyelectrolyte layers is a negatively charged layer.

9. The microchannel device of claim 1, wherein an outermost layer of said polyelectrolyte layers is a positively charged layer.

10. The microchannel device of claim 1, wherein an outermost layer of said polyelectrolyte layers disposed on a first portion of said microchannel surface is negatively charged and an outermost layer of said polyelectrolyte ~~polyelectrolytic~~ layers disposed on a second portion of said microchannel surface is positively charged.

11. The microchannel device of claim 1, wherein said microchannel comprises at least two subchannels intersecting thereby defining at least three arms.

12. The microchannel device of claim 11, wherein said at least two subchannels form a “T”-shaped pattern consisting of three arms.

13. The microchannel device of claim 11, wherein said at least two subchannels form a cross-shaped consisting of four arms.

14. The microchannel device of claim 11, wherein an outermost layer of said polyelectrolyte layers disposed on a first portion of said microchannel surface and a second portion of said microchannel surface of at least one of said at least three arms has a charge opposite a charge on an outermost layer of said polyelectrolyte layers disposed on said first portion and said second portion of a remaining arm.

15. The microchannel device of claim 11, wherein an outermost layer of said polyelectrolyte layers disposed on a first portion of said microchannel surface of one said arm is negatively charged and an outermost layer of said polyelectrolyte layers disposed on a second portion of said microchannel surface of said one arm is positively charged.

16. The microchannel device of claim 11, wherein an outermost layer of said polyelectrolyte layers disposed on a first portion of said microchannel surface and a second portion of said microchannel surface of at least one of said at least three arms has a charge opposite a charge on an outermost surface of said polyelectrolyte layers

disposed on a first portion of said microchannel surface and a second portion of said microchannel surface of at least one remaining arm.

17. The microchannel device of claim 11, wherein an outermost layer of said polyelectrolyte layers disposed on a bottom surface of said microchannel comprises a negatively charged portion and a positively charged portion.

18. The microchannel device of claim 11, wherein said lid surface comprises a negatively charged portion and a positively charged portion formed thereon.

19. The microchannel device of claim 1, further comprising one of the group consisting of proteins, antibodies, and DNA disposed on an outermost layer of said polyelectrolytic layers.

20. The microchannel device of claim 1, further comprising one of the group consisting of proteins, antibodies, and DNA disposed within selected layers of said polyelectrolyte layers.

21. The microchannel device of claim 1, wherein said microchannel has a geometry selected from the group consisting of trapezoidal, semicircular, rectangular, and square.

22. A method of manufacturing a microchannel device, said method comprising the steps of:

providing a plastic substrate with a microchannel formed therein, the microchannel having at least one spatial dimension that are in the micrometer-size range;

exposing selected surfaces of the microchannel to a first solution comprising positively charged polyelectrolytes;

exposing the selected surfaces of the microchannel to a second solution comprising negatively charged polyelectrolytes; and

repeating said steps of exposing the selected surfaces of the microchannel to the first solution and said exposing the selected surfaces of the microchannel to the second solution, alternately, as necessary, to form a desired number of polyelectrolyte multilayers on the selected surfaces.

23. The method of claim 22, wherein said steps of exposing the selected surface produces a positively charged microchannel.

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24. The method of claim 22, wherein the ~~positively~~ negatively charged polyelectrolytes comprise poly (styrene sulfonate).

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25. The method of claim 22, wherein the ~~negatively~~ positively charged polyelectrolytes comprise poly (allylamine hydrocholide).

26. The method of claim 22, wherein said steps of exposing the surfaces of the microchannel to the first solution and exposing the surfaces of the second solution comprises filling the microchannel with the respective solution and allowing the respective polyelectrolyte to adsorb to the selected surfaces or previous layer of the microchannel.

27. The method of claim 22, wherein said step of providing a substrate further comprises providing a lid over the microchannel, the lid having a lid surface facing the microchannel.

28. The method of claim 22, wherein the lid surface has a charge opposite a charge on an outmost layer of the polyelectrolytic multilayers.

29. The method of claim 22, wherein the lid is placed over the channel prior to PEM deposition and the lid is derivatized in a similar manner as the selected surfaces of the microchannel.

30. The method of claim 22, further comprising the step of selectively depositing a charged layer on a selected first microchannel surface having a charge opposite a charge on an outermost layer disposed on a selected second microchannel surface.

31. The method of claim 30, wherein said step of selectively depositing a charged layer comprises:

using a laminar flow patterning to fill one half of the microchannel with a selected polyelectrolyte solution having a charge opposite a charge of an outermost layer of the polyelectrolyte multilayers and to fill the other half of the microchannel with a solution that does not contain the selected polyelectrolyte.

32. The method of claim 22, wherein the microchannel is formed from two intersecting subchannels thereby defining at least three arms.

33. The method of claim 32, wherein the selected surfaces are surfaces of one of the arms.

34. The method of claim 32, further comprising selectively exposing the surfaces of at least one said arm to a desired charged polyelectrolyte solution having a charge opposite a charge of an outermost layer of the polyelectrolyte layers on the surfaces of at least one remaining arm.

35. The method of claim 22, further comprising the step of re-generating an outermost layer of the polyelectrolyte multilayers by re-exposing the selected surfaces to the polyelectrolyte solution last applied.

36. The method of claim 22, further comprising the step of immobilizing selected molecules to an outermost layer of the polyelectrolyte multilayers.

37. The method of claim 36, wherein the molecules are selected from the group consisting of proteins, antibodies and DNA.

38. The method of claim 37, wherein said step of immobilizing the selected molecules comprises adding the selected molecules to at least one of the first solution and second solution.

39. A microchannel device, comprising:

a plastic substrate having a microchannel formed therein, said microchannel having, a first microchannel wall portion and a second microchannel wall portion;

a first polyelectrolyte layer disposed as an outermost surface on said first microchannel wall portion and a second polyelectrolyte layer disposed as an outermost surface on said second microchannel wall portion, said first polyelectrolyte layer and said second polyelectrolyte layer having opposite charges; and

a lid disposed over said microchannel and having a lid surface facing said microchannel.

40. The microchannel device of claim 39 wherein said first polyelectrolyte layer comprises an outermost layer of a first polyelectrolyte multilayer disposed on said first microchannel wall portion.

41. The microchannel device of claim 39 wherein said second polyelectrolyte layer comprises an outermost layer of a second polyelectrolyte multilayer disposed on said second microchannel wall portion.

42. The microchannel device of claim 40, wherein said plastic substrate comprises a plastic selected from the group consisting of polystyrene, poly (ethylene terephthalate glycol), poly (methyl methacrylate), and polycarbonate.

43. The microchannel device of claim 40, wherein said first polyelectrolyte layer comprises poly (allylamine hydrochloride) ~~poly (styrene sulfonate)~~.

44. The microchannel device of claim 40, wherein said second polyelectrolyte layer comprises poly poly(styrene sulfonate) ~~(allylamine hydrochloride).~~

45. A method of manufacturing a microchannel device, said method comprising the steps of:

providing a plastic substrate with a microchannel ~~microchannel~~ formed therein, said microchannel having a first microchannel wall surface and a second microchannel wall surface; and

forming at least one polyelectrolyte layer on selected microchannel surfaces of the microchannel by exposing selected portions of the first microchannel wall surface and the second microchannel wall surface to a first solution comprising first charged polyelectrolytes; and

selectively exposing selected portions of the first microchannel wall surface with a second solution comprising second charged polyelectrolytes, the second charged polyelectrolytes having a charge opposite to that of the first polyelectrolytes.

46. The method of claim 45, wherein said step of forming at least one polyelectrolyte layer further comprises the steps of:

exposing the selected portions of the first sidewall surface and the selected portions of the second sidewall surface of the microchannel to the second solution; and

repeating, alternately, exposing the selected portions of the first sidewall surface and the selected portions of the second sidewall surface the first solution and exposing the selected portions of the first sidewall surface and the selected portions of the second sidewall surface the second solution, as necessary, to form a desired number of polyelectrolyte ~~polyelectrolytic~~ layers.